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(54) USE OF CUTTINGS TANK FOR SLURRIFICATION ON DRILLING RIG

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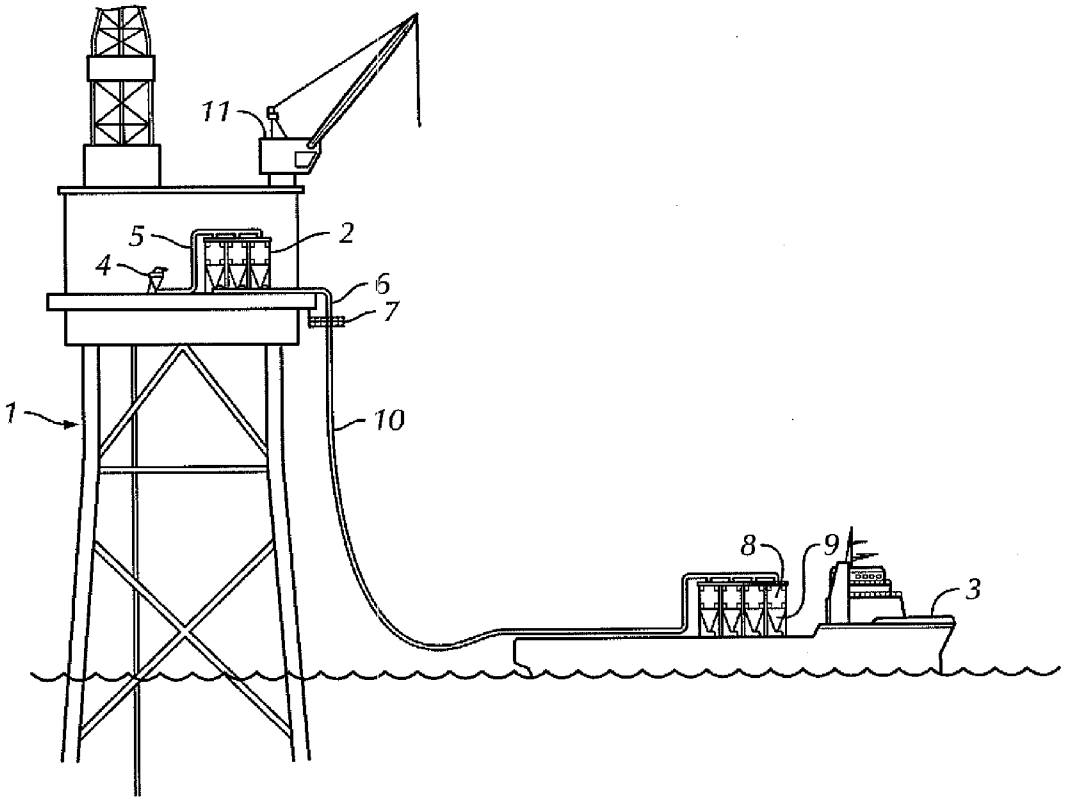
(57) **ABSTRACT**

A system for preparing slurry on a rig including a first cuttings storage vessel, a module, and a fluid supply line in fluid communication with the first cuttings storage vessel, the module including a grinding device configured to facilitate the transfer of fluids, an inlet connection configured to connect to an outlet of the first cuttings storage vessel, and an outlet connection configured to connect to an inlet of the first cuttings storage vessel is disclosed. A method of operating a slurrification system including using a first vessel for cuttings storage and operating the first vessel in a slurrification process is also disclosed. A method of transferring material from a work site to a transport vehicle, the method including transferring a first material from a first cuttings storage vessel disposed at the work site to a cuttings storage assembly disposed on the transport vehicle, and transferring a second material from a second cuttings storage vessel disposed at the work site to the cuttings storage assembly disposed on the transport vehicle, wherein the transferring of the first material and the transferring of the second material occurs contemporaneously, and wherein the first material comprises dry cuttings and the second material comprises a fluid is also disclosed.



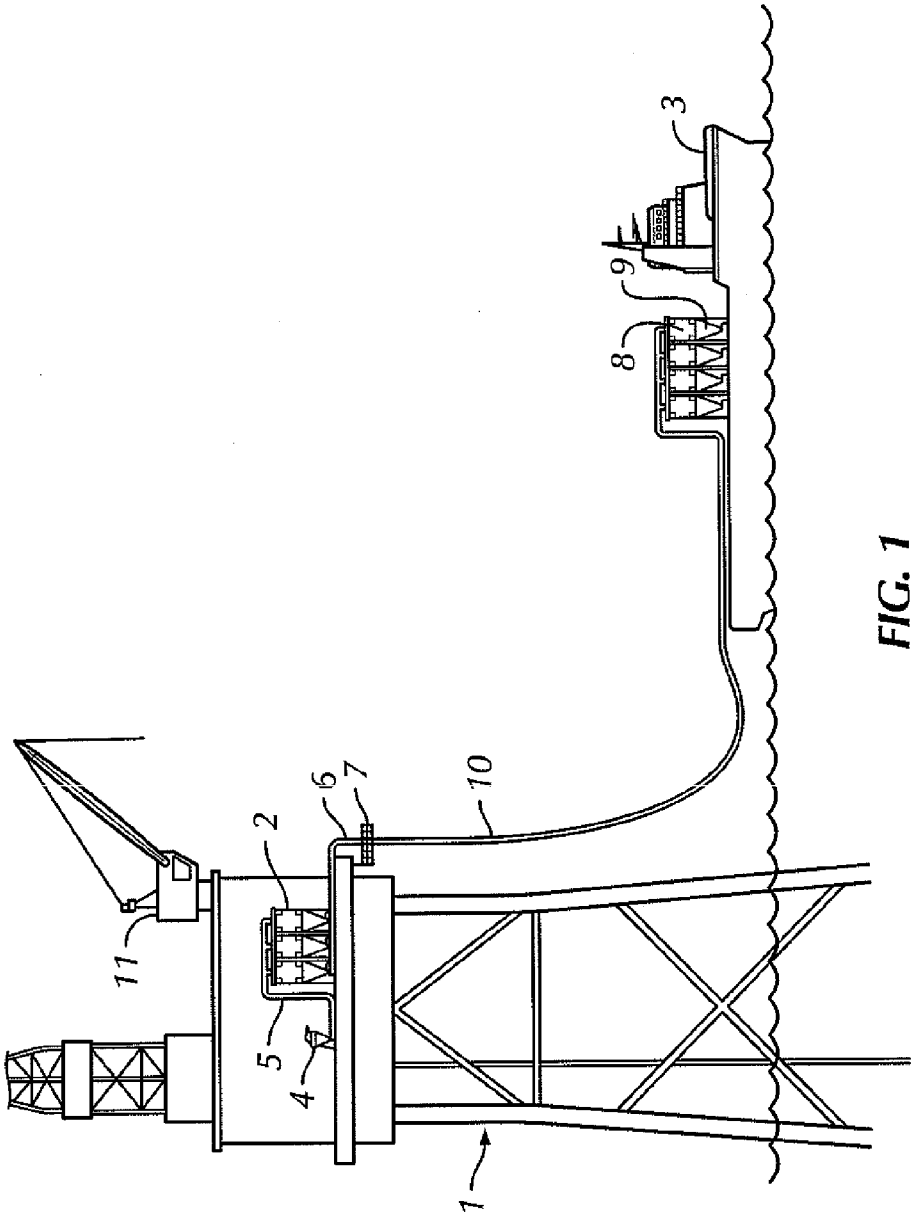


FIG. 1

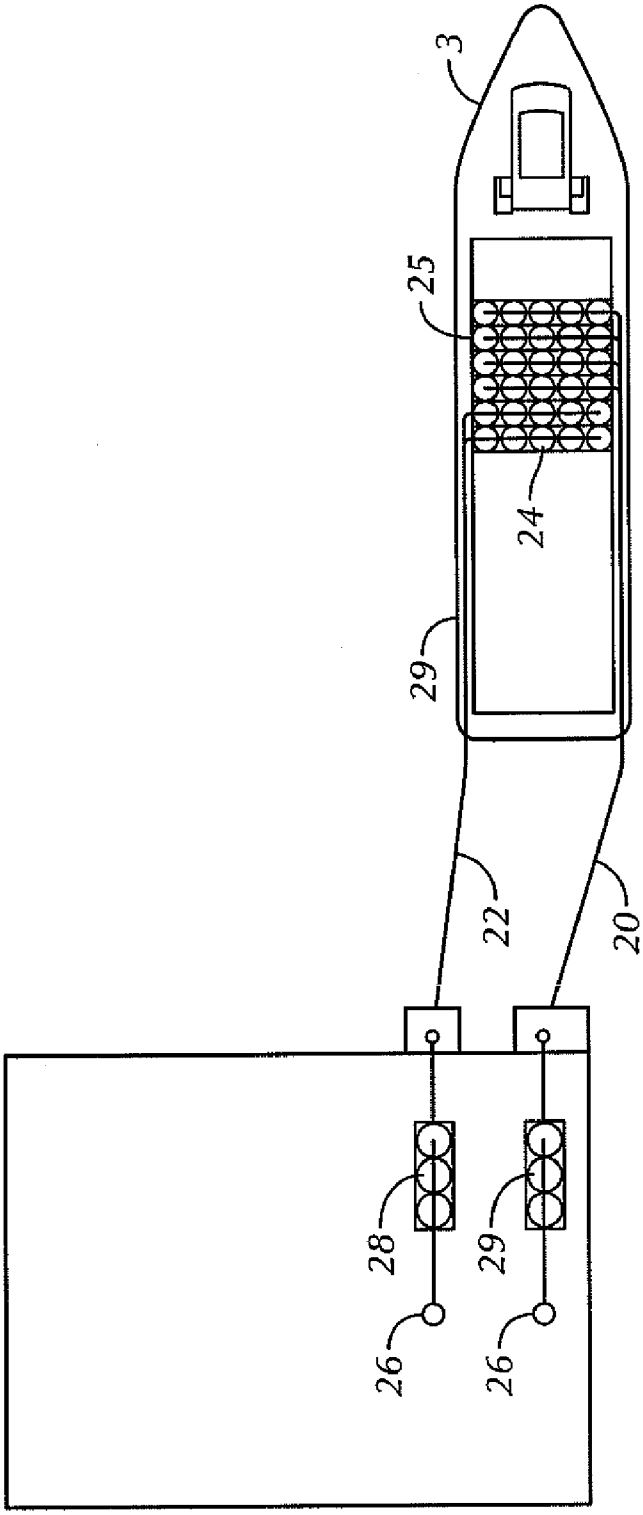


FIG. 2

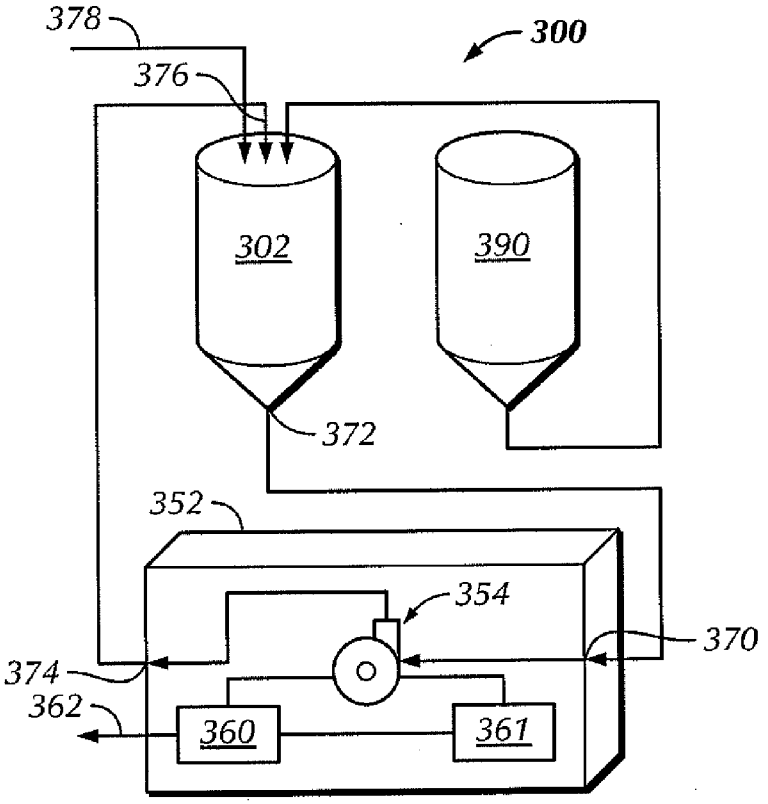

378
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FIG. 3

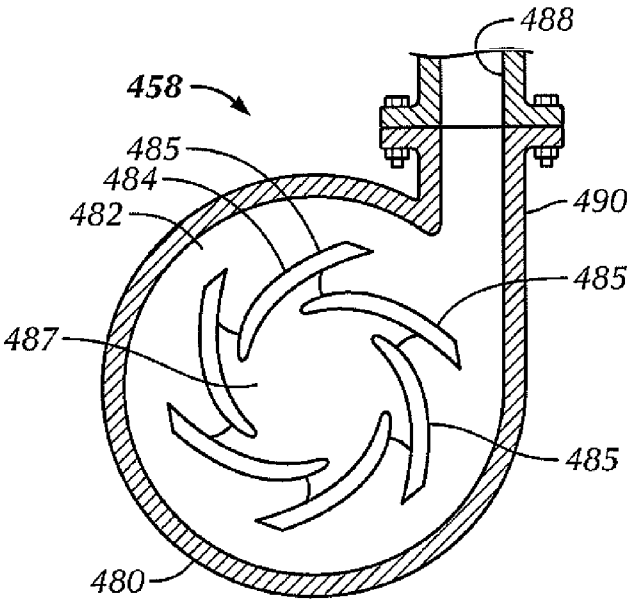
488
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FIG. 4

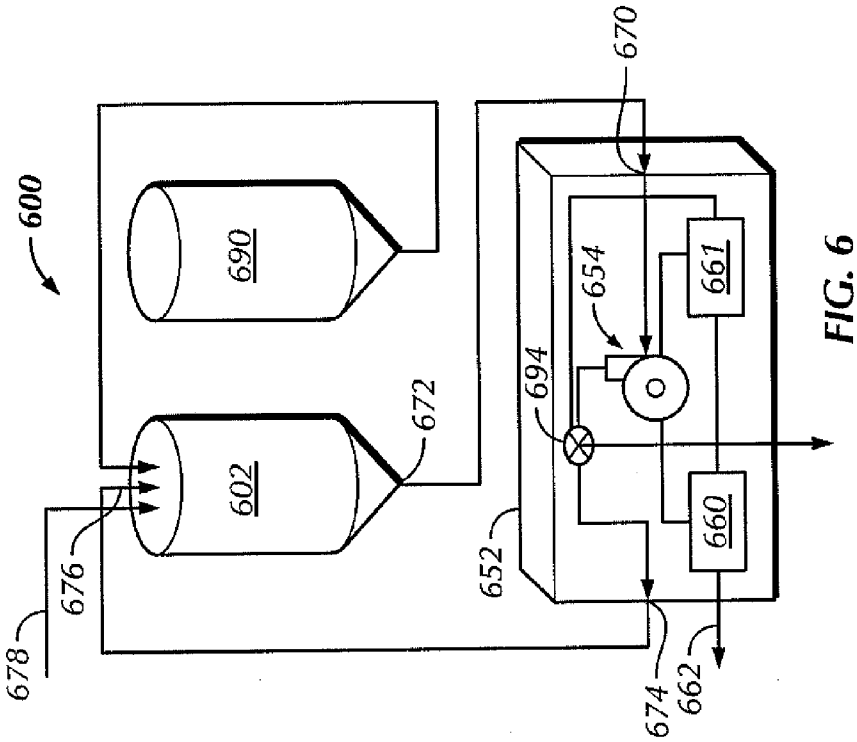
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FIG. 6

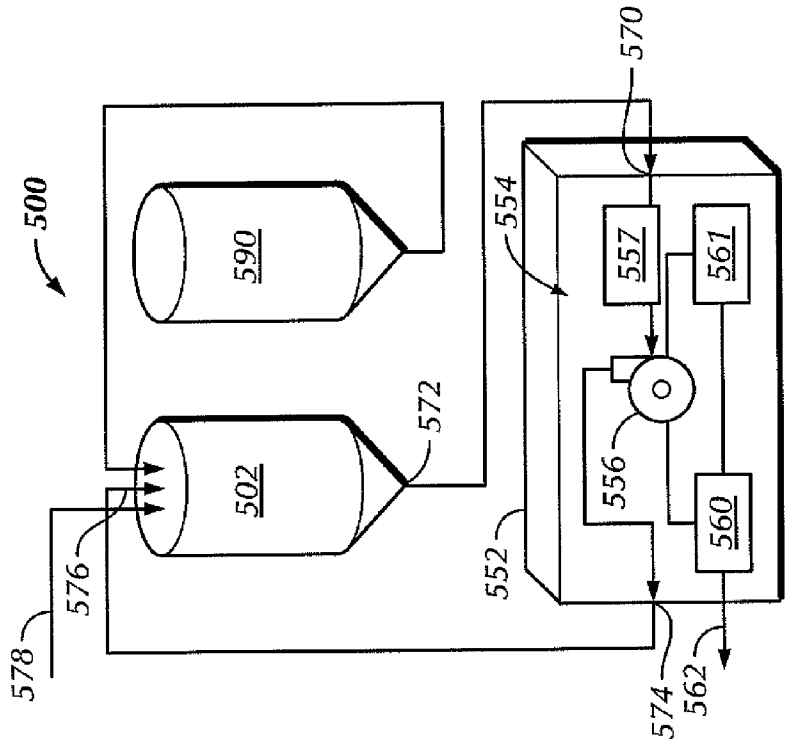
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FIG. 5

USE OF CUTTINGS TANK FOR SLURRIFICATION ON DRILLING RIG

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application, pursuant to 35 U.S.C. §119(e), claims priority to U.S. Provisional Application Ser. No. 60/887,442, filed Jan. 31, 2007. That application is incorporated by reference in its entirety.

BACKGROUND

[0002] 1. Field of the Invention

[0003] Embodiments disclosed herein relate generally to a system for slurrification of drill cuttings on a drill rig. More particularly, embodiments disclosed herein relate to a slurrification system and method of operating the slurrification system that that includes connecting a module to a cuttings storage vessel disposed on a rig.

[0004] 2. Background Art

[0005] In the drilling of wells, a drill bit is used to dig many thousands of feet into the earth's crust. Oil rigs typically employ a derrick that extends above the well drilling platform. The derrick supports joint after joint of drill pipe connected end-to-end during the drilling operation. As the drill bit is pushed further into the earth, additional pipe joints are added to the ever lengthening "string" or "drill string". Therefore, the drill string typically includes a plurality of joints of pipe.

[0006] Fluid "drilling mud" is pumped from the well drilling platform, through the drill string, and to a drill bit supported at the lower or distal end of the drill string. The drilling mud lubricates the drill bit and carries away well cuttings generated by the drill bit as it digs deeper. The cuttings are carried in a return flow stream of drilling mud through the well annulus and back to the well drilling platform at the earth's surface. When the drilling mud reaches the platform, it is contaminated with small pieces of shale and rock that are known in the industry as well cuttings or drill cuttings. Once the drill cuttings, drilling mud, and other waste reach the platform, a "shale shaker" is typically used to remove the drilling mud from the drill cuttings so that the drilling mud may be reused. The remaining drill cuttings, waste, and residual drilling mud are then transferred to a holding trough for disposal. In some situations, for example with specific types of drilling mud, the drilling mud may not be reused and it must be disposed. Typically, the non-recycled drilling mud is disposed of separate from the drill cuttings and other waste by transporting the drilling mud via a vessel to a disposal site.

[0007] The disposal of the drill cuttings and drilling mud is a complex environmental problem. Drill cuttings contain not only the residual drilling mud product that would contaminate the surrounding environment, but may also contain oil and other waste that is particularly hazardous to the environment, especially when drilling in a marine environment.

[0008] In the Gulf of Mexico, for example, there are hundreds of drilling platforms that drill for oil and gas by drilling into the subsea floor. These drilling platforms may be used in places where the depth of the water is many hundreds of feet. In such a marine environment, the water is typically filled with marine life that cannot tolerate the disposal of drill cuttings waste. Therefore, there is a need for a simple, yet workable solution to the problem of disposing of well drill cuttings, drilling mud, and/or other waste in offshore marine environments and other fragile environments.

[0009] Traditional methods of disposal include dumping, bucket transport, cumbersome conveyor belts, screw conveyors, and washing techniques that require large amounts of water. Adding water creates additional problems of added volume and bulk, pollution, and transport problems. Installing conveyors requires major modification to the rig area and involves extensive installation hours and expense.

[0010] Another method of disposal includes returning the drill cuttings, drilling mud, and/or other waste via injection under high pressure into an earth formation. In general, the injection process involves the preparation of a slurry within surface-based equipment, and pumping the slurry into a well that extends relatively deep underground into a receiving stratum or adequate formation. The basic steps in the process include the identification of an appropriate stratum or formation for the injection; preparing an appropriate injection well; formulation of the slurry, which includes considering such factors as weight, solids content, pH, gels, etc.; performing the injection operations, which includes determining and monitoring pump rates such as volume per unit time and pressure; and capping the well.

[0011] Material to be injected back into a formation must be prepared into a slurry acceptable to high pressure pumps used in pumping material down a well. The particles are usually not uniform in size and density, thus making the slurrification process complicated. If the slurry is not the correct density, the slurry often plugs circulating pumps. The abrasiveness of the material particles may also abrade the pump impellers causing cracking. Some centrifugal pumps may be used for grinding the injection particles by purposely causing pump cavitation.

[0012] In some instances, the cuttings, which are still contaminated with some oil, are transported from a drilling rig to an offshore rig or ashore in the form of a thick heavy paste or slurry for injection into an earth formation. Typically the material is put into special skips of about 10 ton capacity that are loaded by crane from the rig onto supply boats. This may be a difficult and dangerous operation that may be laborious and expensive.

[0013] U.S. Pat. No. 6,709,216 and related patent family members disclose that cuttings may also be conveyed to and stored in an enclosed, transportable vessel, where the vessel may then be transported to a destination, and the drill cuttings may be withdrawn. The transportable storage vessel has a lower conical section structured to achieve mass flow of the mixture in the vessel, and withdrawal of the cuttings includes applying a compressed gas to the cuttings in the vessel. The transportable vessels are designed to fit within a 20 foot ISO container frame. These conical vessels will be referred to herein as ISO vessels.

[0014] As described in U.S. Pat. No. 6,709,216 and family, the ISO vessels may be lifted onto a drilling rig by a rig crane and used to store cuttings. The vessels may then be used to transfer the cuttings onto a supply boat. The cuttings may be transferred by pipe lines or, alternatively, the storage vessels containing cuttings may be lifted off the rig by cranes and transported by a supply boat. When a supply boat is not present, the vessels may also serve as buffer storage.

[0015] Space on offshore platforms is limited. In addition to the storage and transfer of cuttings, many additional operations take place on a drilling rig, including tank cleaning,

slurrification operations, drilling, chemical treatment operations, raw material storage, mud preparation, mud recycle, mud separations, and others.

[0016] Due to the limited space, it is common to modularize these operations and to swap out modules when not needed or when space is needed for the equipment. For example, cuttings containers may be offloaded from the rig to make room for modularized equipment used for slurrification. These lifting operations, as mentioned above, may be difficult, dangerous, and expensive. Additionally, many of these modularized operations are self contained, and therefore, include redundant equipment, such as pumps, valves, and tanks or storage vessels.

[0017] Slurrification systems may be disposed in portable units that may be transported from one work site to another. As disclosed in U.S. Pat. No. 5,303,786, a slurrification system may be mounted on a semi-trailer that may be towed between work sites. The system includes, inter alia, multiple tanks, pumps, mills, grinders, agitators, hoppers, and conveyors. As discussed in U.S. Pat. No. 5,303,786, the slurrification system may be moved to a site where a large quantity of material to be treated is available, such as existing or abandoned reserve pits that hold large quantities of cuttings.

[0018] Slurrification systems that may be moved onto a rig are typically large modules that are fully self-contained, receiving cuttings from a drilling rig's fluid mud recovery system. For example, PCT Publication No. WO 99/04134 discloses a process module containing a first slurry tank, grinding pumps, a system shale shaker, a second slurry tank, and optionally a holding tank. The module may be lifted by a crane on to an offshore drilling platform. While theses systems and methods provide improved processes in slurrification and re-injection systems, they require difficult, dangerous, and expensive lifting and installation operations, as described above.

[0019] Accordingly, there exists a continuing need for systems and methods for efficiently preparing slurries for re-injection at a drilling location.

SUMMARY OF INVENTION

[0020] In one aspect, embodiments disclosed herein relate to a system for preparing slurry on a rig including a first cuttings storage vessel, a module, and a fluid supply line in fluid communication with the first cuttings storage vessel, the module including a grinding device configured to facilitate the transfer of fluids, an inlet connection configured to connect to an outlet of the first cuttings storage vessel, and an outlet connection configured to connect to an inlet of the first cuttings storage vessel.

[0021] In another aspect, embodiments disclosed herein relate to a module including a grinding device configured to facilitate the transfer of fluids, an inlet connection configured to connect to an outlet of a first cuttings storage vessel disposed on a rig, and an outlet connection configured to connect to an inlet of the first cuttings storage vessel.

[0022] In another aspect, embodiments disclosed herein relate to a method of operating a slurrification system including using a first vessel for cuttings storage and operating the first vessel in a slurrification process.

[0023] In yet another embodiment, embodiments disclosed herein relate to a method of transferring material from a work site to a transport vehicle, the method including transferring a first material from a first cuttings storage vessel disposed at the work site to a cuttings storage assembly disposed on the transport vehicle, and transferring a second material from a second cuttings storage vessel disposed at the work site to the cuttings storage assembly disposed on the transport vehicle, wherein the transferring of the first material and the transferring of the second material occurs contemporaneously, and wherein the first material comprises dry cuttings and the second material comprises a fluid.

[0024] Other aspects and advantages of embodiments disclosed herein will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0025] FIG. **1** shows a method of offloading drill cuttings from an off-shore rig in accordance with an embodiment of the present disclosure.

[0026] FIG. **2** shows a top view of a system for transferring material from an off-shore rig in accordance with an embodiment of the present disclosure.

[0027] FIG. **3** shows a slurrification system in accordance with embodiments of the present disclosure.

[0028] FIG. **4** shows a grinding device in accordance with embodiments of the present disclosure.

[0029] FIG. **5** shows a slurrification system in accordance with embodiments of the present disclosure.

[0030] FIG. **6** shows a slurrification system in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION

[0031] In one aspect, embodiments of the present disclosure relate to a system for preparing a slurry on a rig, including a module configured to be connected to at least one cuttings storage vessel on the rig. In another aspect, embodiments of the present disclosure relate to a module that includes a grinding device and inlet and outlet connections configured to connect to an outlet and an inlet of a cuttings storage vessel disposed on the rig. In another aspect, embodiments of the present disclosure relate to a method of operating a slurrification system that includes using a vessel for cutting storage, and using the same vessel for a slurrification process. In yet another aspect, embodiments disclosed herein relate to a method of converting a cuttings storage vessel for use in a slurrification process by connecting a module, as disclosed in embodiments herein, to the cuttings storage vessel.

[0032] Referring initially to FIG. **1**, a method of offloading drill cuttings from an off-shore drilling rig according to one embodiment of the present disclosure is shown. In this embodiment, an offshore oil rig **1** may have one or more cuttings storage vessels **2** located on its platform. Cuttings storage vessels **2** may include raw material storage tanks, waste storage tanks, or any other vessels commonly used in association with drilling processes. Specifically, cuttings storage vessels **2** may include cuttings boxes, ISO-tanks, and pneumatic conveying vessels. In some embodiments, cuttings storage vessels **2** may include several individual vessels connected to allow the transference of cuttings therebetween. Such cuttings storage vessels **2** may be located within a support framework (not shown), such as an ISO container frame. As such, those of ordinary skill in the art will appreciate that cuttings storage vessels **2** may be used for both drill cuttings storage and transport.

[0033] As described above with respect to prior art methods, when cuttings storage vessels **2** are no longer needed during a drilling operation, or temporarily not required for

operations taking place on the drilling rig, cuttings storage vessels **2** may be offloaded to a transport vehicle, for example, a supply boat **3**. Other systems and vessels for performing different operations may then be lifted onto the rig via crane **11**, and placed where vessels **2** were previously located. In this manner, valuable rig space may be saved; however, conserving space in this manner may require many dangerous and costly crane lifts.

[0034] In contrast to the prior art methods describe above, embodiments disclosed herein integrate vessels **2** into two or more operations that are performed on drilling rig **1**. In one aspect, embodiments disclosed herein relate to integrating cuttings storage vessels **2** to operate in at least two operations on rig **1**. In some aspects, embodiments disclosed herein relate to integrating cuttings storage vessels **2** to be used for cuttings storage and/or transport, as well a second operation performed on a rig. More specifically, embodiments disclosed herein relate to using cuttings storage vessels **2** as both a storage/transfer vessel, as well as a component in a slurrification system. Although described with respect to integrating cuttings storage vessels into a slurrification system, one skilled in the art will appreciate that any vessel located on a rig platform or other drilling location for a given operation may be integrated into the systems and methods for slurrification disclosed herein.

[0035] Referring still to FIG. **1**, offshore oil rig **1** may include one or more cuttings storage vessels **2** located on its platform. Drill cuttings generated during the drilling process may be transferred to cuttings storage vessels **2** for storage and/or subsequent transfer in a number of different ways. One such method of transferring drill cuttings is via a pneumatic transfer system including a cuttings blower **4** and pneumatic transfer lines **5**. Examples of systems using forced flow pneumatic transfer are disclosed in U.S. Pat. Nos. 6,698,989, 6,702,539, and 6,709,216, all incorporated by reference herein. However, those of ordinary skill in the art will appreciate that other methods for transferring cuttings from a separatory or cleaning operation (e.g., using vibratory separators) to cuttings storage vessels **2** may include augers, conveyors, and pneumatic suction or vacuum systems.

[0036] In a system using pneumatic cuttings transfer, when cuttings need to be offloaded from rig **1** to supply boat **3**, cuttings may be discharged through pipe **6** to a hose connection pipe **7**. Supply boat **3** is fitted with a storage assembly **8**, wherein storage assembly **8** may include a number of additional cuttings storage vessels **9**, including, for example, pneumatic conveying vessels. Supply boat **3** may be brought proximate to rig **1**, and a flexible hose **10** extended therebetween. In this embodiment, flexible hose **10** connects storage assembly **8** to cuttings storage vessels **2** via connection pipe **7**.

[0037] In one embodiment, as shown in FIG. **2**, two discrete streams of materials may be transferred contemporaneously (i.e., at least partially during the same time interval) to a transport vehicle, for example, supply boat **3**. In this embodiment, a first supply line **20** may transfer a first material from at least a first storage vessel **29** to supply boat **3** and a second supply line **22** may transfer a second material from at least a second storage vessel **28** to supply boat **3**. The first and second materials may be transferred to a cuttings storage assembly **25** disposed on supply boat **3**. Alternatively, the first and second materials may be transferred to a storage tank (not shown) disposed on or below the deck of supply boat **3**.

[0038] In one embodiment, the first material may include dry cuttings, while the second material includes a fluid. One of ordinary skill in the art will appreciate that a fluid may include a liquid, a slurry, or a gelatinous material. Additionally, one of ordinary skill in the art will appreciate that dry cuttings may include cuttings processed by a separatory cleaning system or thermal treatment system, and as such, may include small amounts of residual fluids, hydrocarbons, and/or other chemical additives used during the cleaning process. Pumps (not shown) may be coupled to the storage vessels **28**, **29** to facilitate the transfer of material, including, for example, dry cuttings, a fluid, or a slurry, from a separatory cleaning operation or thermal treatment system on the rig to supply boat **3**. Alternatively, a pneumatic transfer system **26** may be coupled to the storage vessels **28**, **29** to transfer materials, including dry cuttings, fluids, and slurries, to the supply boat **3**. In one embodiment, the pneumatic transfer system **26** may include a forced flow pneumatic transfer system as disclosed in U.S. Pat. Nos. 6,698,989, 6,702,539, and 6,709,216. Providing contemporaneous transfer of discrete material streams (e.g, dry cuttings, fluids), may reduce the transportation time between a rig and a transport vehicle, such as, supply boat **3**.

[0039] In one embodiment, cuttings storage assembly **25** may include at least one cuttings storage vessel **24**. As such, the first material and the second material may be transferred to a single cuttings storage vessel **24** of cuttings storage assembly **25**. In another embodiment, the first material and the second material may be transferred to separate cuttings storage vessels **24** of cuttings storage assembly **25**. In one embodiment, a cutting storage vessel **24** disposed on the supply boat **3** may be used in a slurrification system, as disclosed below with reference to cuttings storage vessels disposed on a rig. In this embodiment, briefly, a module (not shown) may be operatively connected to the cuttings storage assembly **25** to incorporate existing cuttings storage vessels **24** into a slurrification system.

[0040] Integration of a cuttings storage vessel into a slurrification system is now described with respect to a cuttings storage vessel disposed on a rig. One of ordinary skill in the art, however, will appreciate that the cuttings storage vessel may be disposed at any work site, including a rig, a transport vehicle, or other treatment facility, without departing from the scope of embodiments disclosed herein. In this embodiment a module may be disposed at the work site proximate the cuttings storage vessel and operatively connected to the cuttings storage vessel, thereby converting the cuttings storage vessel from a vessel for storing cuttings to a component of a slurrification system.

[0041] As described above, previous fluid slurrification systems required the conversion of valuable drilling rig space for storing independent fluid recovery vessels and processing equipment. However, embodiments disclosed herein allow existing structural elements (i.e., cuttings storage vessels **202**) to be used in multiple operations. Modules in accordance with embodiments disclosed herein are relatively small compared to previous systems, thereby preserving valuable drill space, and preventing the need for costly and dangerous lifting operations. Those of ordinary skill in the art will appreciate that the system as illustrated in FIGS. **1-3** and **5-6** are only exemplary, and alternate systems incorporating additional components, for example, fluid cleaning components or tank cleaning components, may also be used in combination with slurrification systems disclosed herein. Illustrative examples of such systems are described in greater detail below.

[0042] Referring now to FIG. **3**, a slurrification system **300** incorporating a first cuttings storage vessel **302** is illustrated. Slurrification system **300** includes a module **352**, or drive unit, configured to operatively connect with the first cuttings storage vessel **302**, and a fluid supply line **378**. Module **352** may include a containment unit, a skid, a housing, or a moveable platform configured to house select slurrification system components, as described in more detail below.

[0043] In this embodiment, system **300** includes an independent power source **360** for providing power to components of module **352**. Power source **360** is electrically connected to, for example, grinding device **354** and/or a programmable logic controller (PLC) **361**. Those of ordinary skill in the art will appreciate that such a power source may provide primary or auxiliary power for powering components of module **352**. In other embodiments, power source **360** may be merely an electrical conduit for connecting a power source on a rig (not shown) via an electrical cable **362**, to module **352**.

[0044] Module **352** includes an inlet connection **370** configured to connect with outlet **372** of first cuttings storage vessel **302**, and an outlet connection **374** configured to connect with an inlet **376** of first cuttings storage vessel **302**. Inlet connection **370** may be connected to outlet **372** and outlet connection **374** may be connected to inlet **376** by fluid transfer lines, for example, flexible hoses and/or new or existing piping. Module **352** further includes a grinding device **354** configured to facilitate the transfer of fluids from the first cuttings storage vessel **302**, through the module **352**, and back to the first cuttings storage vessel **302**. Grinding device **354** is configured to reduce the particle size of solid materials of the drill cuttings transferred therethrough.

[0045] In one embodiment, grinding device **354** may include a grinding pump. The grinding pump may be, for example, a centrifugal pump, as disclosed in U.S. Pat. No. 5,129,469, and incorporated by reference herein. As shown in FIG. **4**, a centrifugal pump **458**, configured to grind or reduce the particle size of drill cuttings, may have a generally cylindrical casing **480** with an interior impeller space **482** formed therein. Centrifugal pump **458** may include an impeller **484** with backward swept blades with an open face on both sides, that is, the blades or vanes **485** are swept backward with respect to a direction of rotation of the impeller and are not provided with opposed side plates forming a closed channel between the impeller fluid inlet area **487** and the blade tips. The casing **480** has a tangential discharge passage **488** formed by a casing portion **490**. The concentric casing of centrifugal pump **458** and the configuration of the impeller blades **485** provide a shearing action that reduces the particle size of drill cuttings. The blades **485** of the impeller **484** may be coated with a material, for example, tungsten carbide, to reduce wear of the blades **485**. One of ordinary skill in the art will appreciate that any grinding pump known in the art for reducing the size of solids in a slurry may be used without departing from the scope of embodiments disclosed herein.

[0046] In an alternative embodiment, as shown in FIG. **5**, grinding device **554** may include a pump **556** and a grinder **557**, for example, a ball mill. In this embodiment, cuttings may be injected into the grinder **557**, wherein the particle size of the solids is reduced. The pump **556** may then pump the slurry back to first cuttings vessel **502**. In one embodiment, the pump may include a grinding pump, as disclosed above, as a second grinder, for further reduction of the particle size of solids exiting the grinder **557**.

[0047] Referring back to FIG. **3**, in one embodiment, slurrification system **300** further includes a second cuttings storage vessel **390**. Second cuttings storage vessel **390** may be configured to supply cuttings to first cuttings storage vessel **302**. In one embodiment, a pump (not shown), as known in the art, may be used to transfer the cuttings. In another embodiment, a pneumatic transfer device (not shown), as disclosed above, may be used to transfer the cuttings to the first cuttings storage vessel **302**. One of ordinary skill in the art will appreciate that any method for transferring the cuttings to first storage vessel **302** may be used without departing from the scope of embodiments disclosed herein.

[0048] In one embodiment, module **352** may further include a pneumatic control device (not shown) to control the flowrate of air injected into the cuttings storage vessel **302** by a pneumatic transfer device (not shown). In such an embodiment, an air line (not shown) from an air compressor (not shown) may be coupled to the pneumatic control device (not shown) in module **352** to control a flow of air into first cuttings storage vessel **302**.

[0049] In another embodiment, cuttings may be supplied to first cuttings storage vessel **302** from a classifying shaker (not shown) or other cuttings separation or cleaning systems disposed on the drilling rig. Additionally, multiple cuttings storage vessels may be connected to and supply cuttings to first cuttings storage vessel **302**. In one embodiment, each cuttings storage vessel may be configured to supply cuttings of predetermined sizes, for example, coarse cuttings or fines. Cuttings of a selected size may then be provided to first cuttings storage vessel **302** to form a slurry of a predetermined density. One of ordinary skill in the art will appreciate that the cuttings may be transferred to the first cuttings storage vessel **302** by any means known in the art, for example, by a pump or a pneumatic transfer device, as described above.

[0050] During operation of slurrification system **300**, fluid supply line **378** may be configured to supply a fluid to first cuttings storage vessel **302**. One of ordinary skill in the art will appreciate that the fluid supply line **378** may supply water, sea water, a brine solution, chemical additives, or other fluids known in the art for preparing a slurry of drill cuttings. As the fluid is pumped into first cuttings storage vessel **302**, cuttings from the second cuttings storage vessel **390**, or other components of the rig's cuttings separation system, as described above, may be transferred into first cuttings storage vessel **302**.

[0051] As first cuttings storage vessel **302** fills with fluid and cuttings, the mixture of fluid and cuttings is transferred to module **352** through the inlet connection **370** of the module **352**. In one embodiment, the mixture may be transferred by a pneumatic transfer device, a vacuum system, a pump, or any other means known in the art. In one embodiment, the pneumatic transfer device may include a forced flow pneumatic transfer system. The mixture of fluid and cuttings is pumped through grinding device **354**, wherein the cuttings are reduced in size. The mixture, or slurry, is then pumped back to first cuttings storage vessel **302** via outlet connection **374**. The slurry may cycle back through module **352** one or more times as needed to produce a slurry of a predetermined density or concentration of cuttings as required for the particular application or reinjection formation.

[0052] Referring now to FIG. **6**, in one embodiment, module **652** further includes a valve **694** disposed downstream of grinding device **654**, wherein valve **694** is configured to redirect the flow of the slurry exiting the grinding device **654**. In

one embodiment, a PLC **661** may be operatively coupled to module **652** and configured to close or open the valve **694**, thereby redirecting the flow of the slurry. In one embodiment, the PLC **695** may control the valve **694** to move after a pre-determined amount of time of fluid transfer through module **652**. In another embodiment, a sensor (not shown) may be operatively coupled to the valve **694** to open or close the valve when a pre-determined condition of the slurry is met. For example, in one embodiment, a density sensor (not shown) may be coupled to valve **694**, such that, when the density of the slurry exiting grinding device **654** reaches a pre-determined value, valve **694** moves, i.e., opens or closes, and redirects the flow of the slurry from the first cuttings storage vessel **302** to another cuttings storage vessel, a slurry tank, a skip, or injection pump for injection into a formation.

[0053] In another embodiment, a conductivity sensor (not shown) may be coupled to valve **694**, such that, when the density of the slurry exiting grinding device **654** reaches a predetermined value, valve **694** moves and redirects the flow of the slurry from the first cuttings storage vessel **302** to another cuttings storage vessel, a slurry tank, a skip, or injection pump for injection into a formation. One of ordinary skill in the art will appreciate that other apparatus and methods may be used to redirect the flow of the slurry once a predetermined concentration of cuttings in suspension, density, or conductivity has been met. Commonly, a slurry with a concentration of up to 20% cuttings in suspension is used for re-injection into a formation. However, those of ordinary skill in the art will appreciate that direct injection of slurry, using embodiments of the present disclosure, may provide for increases in concentration of cuttings in the slurry.

[0054] A slurry formed by a slurrification system, as described above, may be transferred to another cuttings storage vessel, a slurry tank, a skip, or directly injected into a formation. Slurry that is transferred to a tank, vessel, skip, or other storage device, may be transferred off-site to another work site. In one embodiment, the storage device may be lifted off of a rig by a crane and transferred to a boat. Alternatively, slurry may be transferred from the storage device to a slurry tank disposed on the boat.

[0055] In one embodiment, the slurry may be transported from one work site to another work site for re-injection. For example, the slurry may be transported from an offshore rig to another offshore rig. Additionally, the slurry may be transported from an offshore rig to an on-land work site. Further the slurry may be transported from an on-land work site to an offshore work site.

[0056] Those of ordinary skill in the art will appreciate that components of systems **300**, **500**, and **600** may be interchanged, interconnected, and otherwise assembled in a slurrification system. As such, to address the specific requirements of a drilling operation, in particular, for cuttings re-injection, the components of the systems and modules disclosed herein may provide for an interchangeable and adaptable system for slurrification at a drilling location.

[0057] Advantageously, embodiments disclosed herein may provide a slurrification system that reduces the amount of required space at a work site to operate the slurrification system. In another aspect, embodiments disclosed herein may provide a slurrification system that reduces the amount of equipment or number of components required to prepare a slurry for re-injection into a formation. In yet another aspect, embodiments disclosed herein may provide a safer slurrification system by reducing the number of crane lifts required to install the system.

[0058] Furthermore, embodiments disclosed herein advantageously provide a module configured to connect to a cuttings storage vessel on a drilling work site, thereby converting a cuttings storage vessel into a component of a slurrification system. As such, modules of the present disclosure may allow for existing infrastructure on an offshore platform to perform multiple functions, such as, allowing cuttings storage vessels to be used in both the storage and transfer of cuttings, as well as, being used in a slurrification system.

[0059] While the invention has been described with respect to a limited number of embodiments, those skilled in the art, having benefit of this disclosure, will appreciate that other embodiments may be devised which do not depart from the scope of the invention as disclosed herein. Accordingly, the scope of the invention should be limited only by the attached claims.

What is claimed:

1. A system for preparing slurry on a rig, the system comprising:
- a first cuttings storage vessel;
- a module comprising:
  - a grinding device configured to facilitate the transfer of fluids,
  - an inlet connection configured to connect to an outlet of the first cuttings storage vessel, and
  - an outlet connection configured to connect to an inlet of the first cuttings storage vessel; and
- a fluid supply line in fluid communication with the first cuttings storage vessel.

2. The system of claim **1**, wherein the grinding device comprises a pump and a grinder.

3. The system of claim **1**, wherein the grinding device comprises a grinding pump.

4. The system of claim **1**, further comprising a second cuttings storage vessel configured to supply cuttings to the first cuttings storage vessel.

5. The system of claim **4**, further comprising a pneumatic transfer device configured to facilitate the transfer of cuttings from the second cuttings storage vessel to the first cuttings storage vessel.

6. A module comprising:
- a grinding device configured to facilitate the transfer of fluids;
- an inlet connection configured to connect to an outlet of a first cuttings storage vessel disposed on a rig; and
- an outlet connection configured to connect to an inlet of the first cuttings storage vessel.

7. The module of claim **6**, wherein the grinding device comprises a pump and a grinder.

8. The module of claim **6**, wherein the grinding device comprises a grinding pump.

9. The module of claim **6**, further comprising a programmable logic controller operatively coupled to the module.

10. A method of operating a slurrification system comprising:
- using a first vessel for cuttings storage; and
- operating the first vessel in a slurrification process.

11. The method of claim **10**, further comprising using the first vessel for cuttings transport.

12. The method of claim **10**, wherein the operating the first vessel in a slurrification process comprises:

connecting a module to the first vessel, the module comprising:

a grinding device configured to facilitate the transfer of fluids;

an inlet connection configured to connect to an outlet of the first vessel; and

an outlet connection configured to connect to an inlet of the first vessel.

13. The method of claim **12**, further comprising providing a fluid to the first vessel.

14. The method of claim **13**, further comprising transferring cuttings from a second vessel into the first vessel.

15. The method of claim **12**, further comprising pumping a mixture of fluids and cuttings from the first vessel though the grinding device via the inlet connection of the module, and returning the mixture to the first vessel via the outlet connection.

16. A method of converting a first cuttings storage vessel for use in a slurrification system, comprising:

connecting the module of claim **6** to at least the first cuttings storage vessel.

17. The method of claim **16**, wherein the connecting the module comprises:

connecting a power supply of the module to a power source; and

connecting at least one fluid transfer line from the module to the first cuttings storage vessel.

18. A method of transferring material from a work site to a transport vehicle, the method comprising:

transferring a first material from a first cuttings storage vessel disposed at the work-site to a cuttings storage assembly disposed on the transport vehicle; and

transferring a second material from a second cuttings storage vessel disposed at the work site to the cuttings storage assembly disposed on the transport vehicle,

wherein the transferring of the first material and the transferring of the second material occurs contemporaneously, and

wherein the first material comprises dry cuttings and the second material comprises a fluid.

19. The method of claim **18**, wherein the cuttings storage assembly comprises at least one cuttings storage vessel.

20. The method of claim **19**, wherein the first material and the second material are transferred to a single cuttings storage vessel of the cuttings storage assembly.

21. The method of claim **18**, further comprising slurrifying the first material and the second material in the cuttings storage assembly.

22. The method of claim **21**, wherein the slurrifying comprises operatively connecting the module of claim **6** to the cuttings storage assembly.

23. The method of claim **18**, wherein the second material comprises a slurry.

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